

## **10G SFP+ LR ( ER+ 1310 ) Transceiver**

### **Hot Pluggable, Duplex LC, 1310nm DFB, SMF 60KM, DDM, I-Temp**

**Part Number: FSPP-H7-S13-60Di**



### **Overview**

FSPP-H7-S13-60Di Small Form Factor Pluggable SFP+ transceivers are compliant with the current SFP+ Multi-Source Agreement (MSA) Specification. The high performance uncooled 1310nm DFB transmitter and high sensitivity APD receiver provide superior performance for 10GBASE-LR/LW applications up to SMF 60km optical links in Industrial Temperature range.

### **Applications**

- 10GBASE-LR/LW Ethernet @10.3125G
- Fiber Channel 800-SM-LC-L 8GFC @8.5G, 1200-SM-LL-L 10GFC @10.51875G
- SONET OC-192 & SDH STM-64 @9.953G
- CPRI Option #7 @9.83G, #8 @10.1376G
- OTN OTU2 @10.7G, OTU2e @11.09G, OTU2f @11.32G

### **Features**

- Compatible with IEEE802.3ae 10GBASE-LR/LW
- Compatible with CPRI Option 7, 8
- Compliant with SFF-8431, SFF-8432 SFP+ MSA
- Support 8.5Gb/s to 11.32Gb/s Multi-Rate
- Hot Pluggable
- 1310nm DFB laser transmitter
- APD receiver
- Duplex LC connector
- 2-wire interface for management and diagnostic monitor compliant with SFF-8472
- Single +3.3V power supply
- Link distance 60km over SM fiber
- Operating Temperature -40~+85°C
- Maximum Power consumption 1.9W
- RoHS Compliant

### **Laser Safety**

- This is a Class 1 Laser Product complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dated May 8, 2019.
- Caution: Use of control or adjustments or performance of procedure other than those specified herein may result in hazardous radiation exposure.



## Absolute Maximum Ratings

| Parameters                | Symbol          | Min. | Max. | Unit |
|---------------------------|-----------------|------|------|------|
| Storage Temperature       | T <sub>ST</sub> | -40  | +85  | °C   |
| Storage Relative Humidity | RH              | 5    | 95   | %    |
| Supply Voltage            | V <sub>CC</sub> | -0.5 | +4.0 | V    |

## Recommended Operating Conditions

| Parameters                 | Symbol          | Min.  | Typ. | Max.  | Unit |
|----------------------------|-----------------|-------|------|-------|------|
| Case Operating Temperature | T <sub>OP</sub> | -40   | -    | +85   | °C   |
| Supply Voltage             | V <sub>CC</sub> | +3.13 | +3.3 | +3.47 | V    |
| Supply Current             | I <sub>CC</sub> |       |      | 550   | mA   |
| Power Consumption          | P               |       |      | 1.9   | W    |

## Transmitter Electro-optical Characteristics

V<sub>CC</sub> = 3.13V to 3.47V, T<sub>OP</sub> = -40 °C to 85 °C

| Parameters                              | Symbol                        | Min.        | Typ.    | Max.            | Unit  | Note |
|-----------------------------------------|-------------------------------|-------------|---------|-----------------|-------|------|
| Operating Data Rate                     | DR                            | 8.5         | 10.3125 | 11.32           | Gb/s  |      |
| Optical Launch Power                    | P <sub>o</sub>                | +3          |         | +6              | dBm   | 1    |
| Optical Center Wavelength               | λ <sub>c</sub>                | 1260        | 1310    | 1355            | nm    |      |
| Spectral Width (-20dB)                  | Δλ                            |             |         | 1               | nm    |      |
| Side Mode Suppression Ratio             | SMSR                          | 30          |         |                 | dB    |      |
| Optical Extinction Ratio                | ER                            | 3.5         |         |                 | dB    |      |
| Optical Eye Mask                        |                               | IEEE802.3ae |         |                 |       |      |
| Relative Intensity Noise                | RIN                           |             |         | -128            | dB/Hz |      |
| Differential Data Input Swing           | V <sub>IN</sub>               | 180         |         | 850             | mV    |      |
| Tx Disable Input Voltage-Low (Tx ON)    | TDISV <sub>L</sub>            | GND         |         | 0.8             | V     |      |
| Tx Disable Input Voltage-High (Tx OFF)  | TDISV <sub>H</sub>            | 2.0         |         | V <sub>CC</sub> | V     |      |
| Tx Fault Output Voltage-Low (Tx Normal) | TFLT <sub>V<sub>L</sub></sub> | GND         |         | 0.8             | V     |      |
| Tx Fault Output Voltage-High (Tx Fault) | TFLT <sub>V<sub>H</sub></sub> | 2.0         |         | V <sub>CC</sub> | V     |      |

**Note1:** The optical power is launched into a 9/125μm single mode fiber.



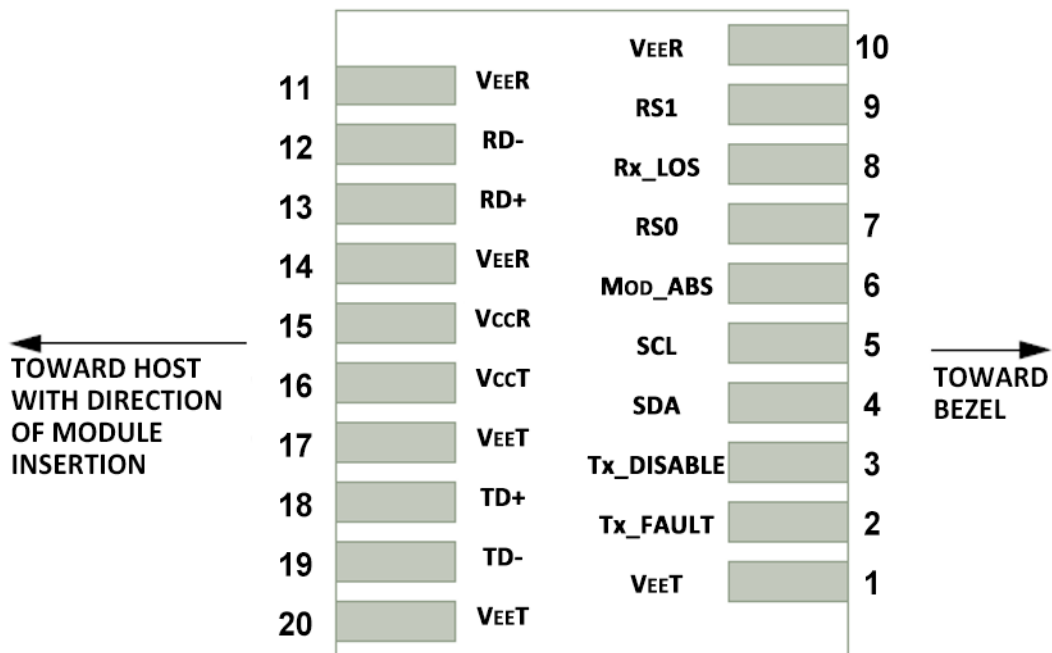
## Receiver Electro-optical Characteristics

V<sub>CC</sub> = 3.13V to 3.47V, T<sub>OP</sub> = -40 °C to 85 °C

| Parameters                              | Symbol            | Min. | Typ.    | Max.            | Unit | Note |
|-----------------------------------------|-------------------|------|---------|-----------------|------|------|
| Operating Data Rate                     | DR                | 8.5  | 10.3125 | 11.32           | Gb/s |      |
| Receiver Sensitivity                    | SEN               |      |         | -22             | dBm  | 1    |
| Maximum Receive Power                   | PRX_MAX           | -7   |         |                 | dBm  | 1    |
| Optical Center Wavelength               | $\lambda_c$       | 1260 |         | 1620            | nm   |      |
| LOS De-Assert                           | LOS <sub>D</sub>  |      |         | -23             | dBm  |      |
| LOS Assert                              | LOS <sub>A</sub>  | -35  |         |                 | dBm  |      |
| LOS Hysteresis                          | LOS <sub>HY</sub> | 0.5  |         |                 | dB   |      |
| Differential Data Output Swing          | V <sub>OUT</sub>  | 300  |         | 900             | mV   |      |
| Receiver LOS Signal Output Voltage-Low  | LOS <sub>VL</sub> | GND  |         | 0.8             | V    |      |
| Receiver LOS Signal Output Voltage-High | LOS <sub>VH</sub> | 2.0  |         | V <sub>CC</sub> | V    |      |

**Note1:** Measured with a PRBS 2<sup>31</sup>-1 test pattern @10.3125Gbps BER<10<sup>-12</sup>.

## Pin Assignment



Host PCB SFP+ Pad Assignment Top View



## Pin Description

| Pin | Name       | Function / Description                                          |
|-----|------------|-----------------------------------------------------------------|
| 1   | VEET       | Transmitter Ground                                              |
| 2   | Tx_FAULT   | Transmitter Fault Indication (1)                                |
| 3   | Tx_DISABLE | Transmitter Disable – Turns off transmitter laser output (2)    |
| 4   | SDA        | 2-wire Serial Interface Data Line (SDA: Serial Data Signal) (3) |
| 5   | SCL        | 2-wire Serial Interface Clock (SCL: Serial Clock Signal) (3)    |
| 6   | MOD_ABS    | Module Absent, connected to VEET or VEER in the module (3)      |
| 7   | RS0        | Rate Select 0, optional (5)                                     |
| 8   | Rx_LOS     | Receiver Loss of Signal Indication (4)                          |
| 9   | RS1        | Rate Select 1, optional (5)                                     |
| 10  | VEER       | Receiver Ground                                                 |
| 11  | VEER       | Receiver Ground                                                 |
| 12  | RD-        | Receiver Inverted Data output, AC coupled                       |
| 13  | RD+        | Receiver Non-Inverted Data output, AC coupled                   |
| 14  | VEER       | Receiver Ground                                                 |
| 15  | VccR       | Receiver 3.3V Power Supply                                      |
| 16  | VccT       | Transmitter 3.3V Power Supply                                   |
| 17  | VEET       | Transmitter Ground                                              |
| 18  | TD+        | Transmitter Non-Inverted Data Input, AC coupled                 |
| 19  | TD-        | Transmitter Inverted Data Input, AC coupled                     |
| 20  | VEET       | Transmitter Ground                                              |

**Note1:** Tx Fault is open collector/drain output which should be pulled up externally with a 4.7K~10KΩ resistor on the host board to supply  $<V_{ccT}+0.3V$  or  $V_{ccR}+0.3V$ . When high, this output indicates a laser fault of some kind. Low indicates normal operation. In the low state, the output will be pulled to  $<0.8V$ .

**Note2:** Tx Disable input is used to shut down the laser output per the state table below. It is pulled up within the module with a 4.7K~10KΩ resistor. 1) Low(0~0.8V): Transmitter on; 2) Between(0.8V and 2V): Undefined; 3) High (2.0~  $V_{ccT}$ ): Transmitter Disabled; 4) Open: Transmitter Disabled.

**Note3:** These are the module definition pins. They should be pulled up with a 4.7K~10KΩ resistor on the host board to supply less than  $V_{ccT}+0.3V$  or  $V_{ccR}+0.3V$ . MOD\_ABS is grounded by the module to indicate that the module is present.

**Note4:** Rx\_LOS (Loss of signal) is an open collector/drain output which should be pulled up externally with a 4.7K~10KΩ resistor on the host board to supply  $<V_{ccT}+0.3V$  or  $V_{ccR}+0.3V$ . When high, this output indicates the received optical power is below the worst case receiver sensitivity (as defined by the standard in use). Low indicates normal operation. In the low state, the output will be pulled to  $<0.8V$ .

**Note5:** Tied to ground through a 30K ohm resistor.



## Digital Diagnostic Functions

As defined by the SFP MSA (SFF-8472) Ficer's SFP+ transceivers provide digital diagnostic functions via a 2-wire serial interface, which allows real-time access to the following operating parameters:

- Transceiver temperature
- Laser bias current
- Transmitted optical power
- Received optical power
- Transceiver supply voltage

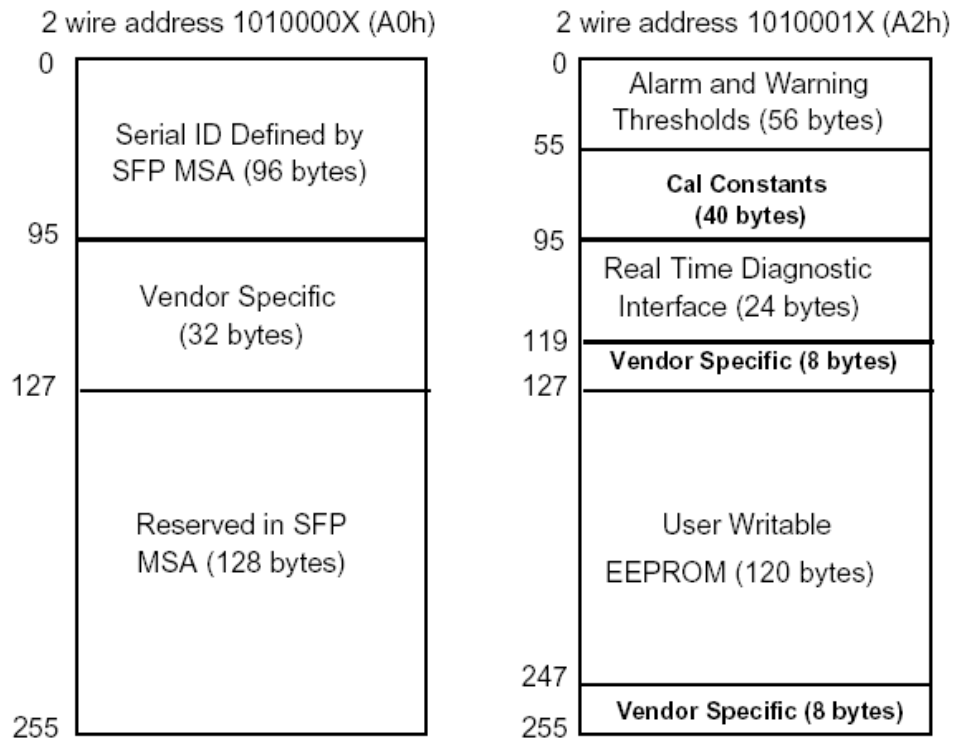
It also provides a sophisticated system of alarm and warning flags, which may be used to alert end-users when particular operating parameters are outside of a factory-set normal range.

The operating and diagnostics information is monitored and reported by a Digital Diagnostics Controller (DDC) inside the transceiver, which is accessed through the 2-wire serial interface. When the serial protocol is activated, the serial clock signal (SCL pin) is generated by the host. The positive edge clocks data into the SFP+ transceiver into those segments of its memory map that are not write-protected. The negative edge clocks data from the SFP+ transceiver. The serial data signal (SDA pin) is bi-directional for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The memories are organized as a series of 8-bit data words that can be addressed individually or sequentially.

For more detailed information including memory map definitions, please see the SFP MSA (SFF-8472) Specification.



## Digital Diagnostic Memory Map

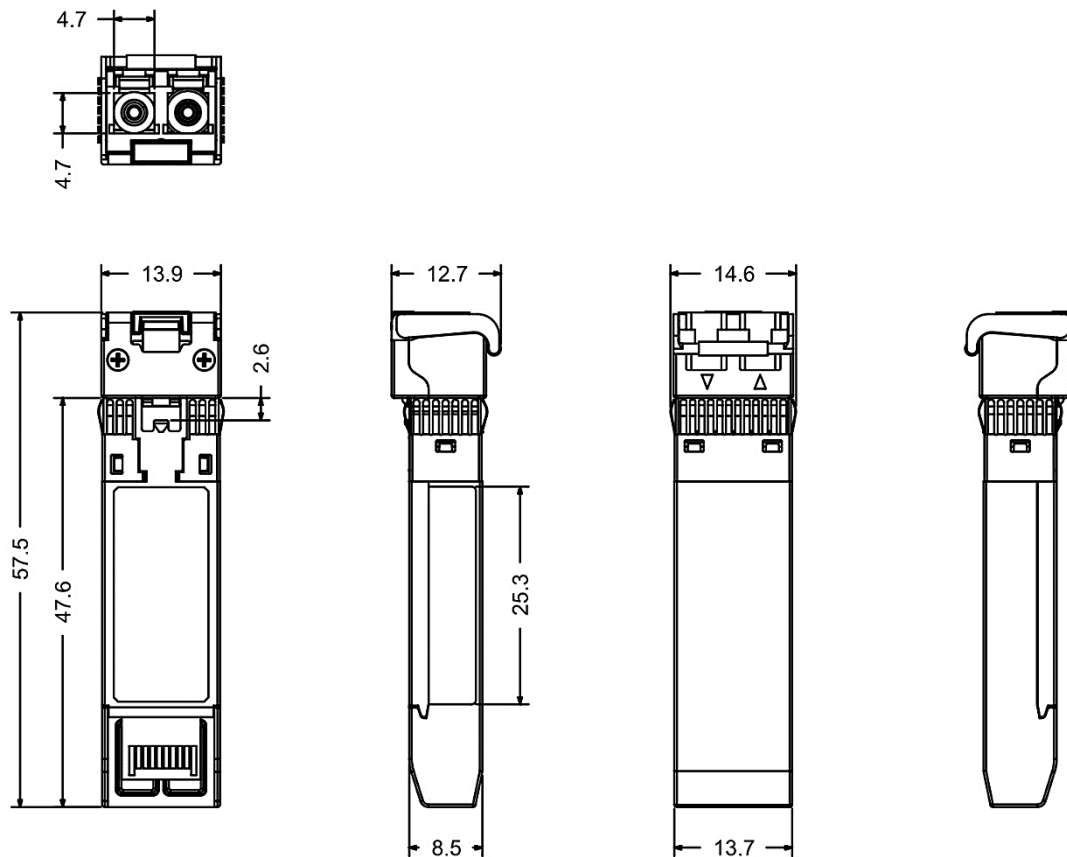


## Digital Diagnostic Monitoring Characteristics

| Parameter                 | Accuracy | Unit | Note                 |
|---------------------------|----------|------|----------------------|
| Temperature               | ±3       | °C   | Internal Calibration |
| Supply Voltage            | ±0.1     | V    | Internal Calibration |
| Tx Bias Current           | ±5       | mA   | Internal Calibration |
| Tx Output Power           | ±3       | dB   | Internal Calibration |
| Rx Received Optical Power | ±3       | dB   | Internal Calibration |



## Mechanical Dimensions



(All Dimensions are  $\pm 0.20\text{mm}$  Unless Otherwise Specified, Unit: mm)

## Ordering Information

| Part No.          | Tx     | Rx                    | Link        | DDM | Temp.    |
|-------------------|--------|-----------------------|-------------|-----|----------|
| FSP-P-H7-S13-60Di | 1310nm | 1260nm<br>~<br>1620nm | SMF<br>60km | Yes | -40~85°C |

**Note:** Distances are indicative only. To calculate a more precise link budget based on specific conditions in your application, please refer to the optical characteristics.